G 576

~~531 l. 19~~
~~12~~

A Catalogue of the Mathematical Works of the Learned Mr. Thomas Baker, *Rector of* Biſhop Nympton *in* Devonſhire, *with a Propoſal about printing the ſame; and firſt one intituled the* GEOMETRICAL KEY, *or the Gate of Æquations Unlockt.*

A New Diſcovery of the Conſtructions of all Æquations howſoever affected, not exceeding the 4*th* degree; *viz.* Of *Linears*, *Quadratics*, *Cubics*, and *Biquadratics*, and the finding of all their Roots as well true as negative, without the uſe of *Meſolabe*, and *Triſection of Angles*; without Reduction, Depreſſion, or any other prævious preparation of Æquations, by a Circle and any (and that but one only) *Parabole*: and this by one only general Rule. than which a more ſimple, more perfect, more general, more eaſy to be underſtood, or more fit for practiſe, cannot be deviſed or wiſhed for.

Fortified with Demonſtrations, Illuſtrated with Figures to each Æquation, which are Exemplyfied with numeral Æquations, (according to all the varieties of Caſes) adapted to each Figure, for the uſe of young Mathematicians: a work hitherto deſired.

THe Treatiſe conſiſts of about a Quire of Paper, the Diſcourſe whereof (but not the *Algebraick Calculus*) is both in *Latin* and *Engliſh*, the better to promote its forreign vend; and this doth not render it above three Sheets the larger than it would have been in one of theſe Languages. Beſides which, there is belonging to it diverſe Draughts of Schemes to be engraven, and one *Folio* Draught, whereto the literal *Calculus* for ſetling the *Center*, and finding the

Radius

Radius of the Circle that is to interſect the *Parabole* is expreſſed in readineſs for all Caſes.

How *Des Cartes* and all other famous *Analyſts* came to miſs this general Rule, and himſelf to fall upon it, he acquaints the Reader in the middle of his Diſcourſe; namely, that they conſidered the Axe of a *Parabole* and not its Diameter: and affirms, that if it had been his or their hap to have deſcribed a Circle from any Point in *Poſition* given, paſſing through the *Vertex* of any Diameter in the *Parabole*, and had taken into conſideration a certain propriety than which none could ſo have ſuited the deſign) belonging to the Diameter of any *Parabole*, they could not but with greateſt eaſe, have made a full diſcovery of the Univerſal Rule.

The excellency of which Invention appears, in that it diſcovers not only the Geometrical Conſtruction of all Æquations as aboveſaid, by one only ſtanding meaſure and Scheme, and that by one only general rule, with the exact number of Roots as well true as negative, but alſo by giving a fair proſpect towards their *Arithmetical Calculus*, or numerous Reſolution, by making a Diſcovery of their two firſt figures or numbers; namely, by applying the Compaſſes to the ſeveral Roots Geometrically found in the Scheme, and comparing them with that very Scale from which the ſaid Scheme (ſuited to the propoſed Æquation) was drawn, the reſidue of which roots, (though not preciſely, yet ſufficient nearly approximating to the true) may diverſe ways in Decimals be found out, which the Author (as he intimated in a Letter of *April* 1682, to Mr. *Collins*) is willing to impart; but as to the Invention of theſe reſiduals (to be entail'd to the two firſt figures or Numbers of this Author thus findable. The Learned Mr. *Iſaac Newton* Profeſſor of Mathematicks in *Cambridge* (in a Letter long ſince communicated to the aforeſaid Mr. *Collins*) hath as to this purpoſe performed the ſame (as is conceived) by a different method, namely, that when a root of any Æquation is by any Method (which by the Authors aforeſaid it may be) ſo near found that it doth not differ above a tenth part of its ſelf from the true root ſought, the reſidue of the root inquired will be eaſily calculated by aid of ſome terms or Fractional parts of an infinite Series or rank of continual Proportionals, derived from the difference between the Reſolvend of the known part of the Root, and that whoſe Root is ſought. By which means by raiſing Reſolvends out of any aſſumed Roots with an eaſy approach, without raiſing the

the reſpective powers of the ſaid Roots, we are delivered from the moſt toilſom Drudgery of Mathematical Calculations, by finding the Roots of Æquations in numbers, by *Vietas* general method; a thing utterly unknown to the Ancients. However this is not ſaid to diſparage that Method which *Vieta* ſo greatly eſteemed, that when he had obtained it, he gave *Algebra* this high *Encomium*, that it did *Nullum non Problema ſolvere*, in his numerical Method Mr. *Oughtred* and *Harriot* have taken commendable pains. But now laſt of all, to perform in Species as Mr. *Iſaac Newton* hath done, ſeems a new Invention never to be ſufficiently praiſed; for out of a literal Æquation of five Dimenſions, ſuppoſing all the terms extant and affirmed, he hath given a Series for the Root in Species, and ſuch a one as ſhall ſerve for finding the Roots of all Equations of 3, 4 or 5 Dimenſions, by only altering the ſigns according as as the Æquation is affected, and expunging ſuch parts as relate to Deficient terms in an incompleat Æquation propoſed.

Now that this admirable Doctrine may come to light, and the Learned Author (who hath many other Treatiſes worthy publick view) may be incited to impart the ſame, encouragements for the promoting thereof (ſeeing Undertakers are not to be had without) muſt be propounded.

It is therefore humbly offered, that the Royal Society by their Treaſurer *&c.* enter into Bond to ſuch Bookſeller as ſhall be the Undertaker, to take of 60 of theſe Books in Quires at 1½ *d.* each Sheet, and as much each Plate, as ſoon as printed.

The Treatiſe it ſelf and the Propoſal, is approved and agreed to by the Council of the Royal Society.

And in regard ſuch a Subſcription is not ſufficient to incite an Undertaker, that the reſpective Members endeavour by virtue of this Narrative, to obtain as many more Subſcribers as they can procure amongſt others that are not of the Society, each of them to advance half a Crown in hand, in part of the former price: upon which encouragements, *Robert Clavel* Bookſeller at the *Peacock* in St. *Pauls Church-Yard*, is ready to give reciprocal ſecurity for the performance according to this Propoſal, hoping the like encouragement will be given towards printing the reſt of the Treatiſe of this moſt Learned Author, whereof take the enſuing Catalogue.

1. The *Hyperbolic Key*, or the Geometrical Conſtruction of *Cubic* and *Biquadratic* Æquations; by a Circle and an equilateral *Hyperbole*; whereof the one moyety (exactly) *viz.* of eight *Cubicks* and four and twenty *Biquadratics*; (as is expreſſed in the former treatiſe) namely,

1. Of all thoſe Cubicks; wherein

   1. The quantity (q) is wanting; and p and r affected with divers Signes.

   2. The quantity (p) is wanting, and in the Æquation be had $-q$.

   3. None of the terms are wanting, and in the Æquation be had $+q$,

2. Of all thoſe *Biquadratic* Æquations in which are had $+s$. by the demiſſion of Perpendiculars, from the points of Interſections of the Circle and Hyperbole to the Aſſymptote; part of the other moyety, by the demiſſion of perpendiculars from the aforeſaid interſections to the axe; *&c.* with Schemes adapted to each Æquation, *&c.* with a Synopſis of the whole, wherein the Literal Rule for fixing the Center, and finding the Radius of the Circle, that is to interſect the Æquilateral Hyperbole (the eaſieſt way of the Conſtruction of which is likewiſe therein diſcovered) is expreſſed in readineſs for all Caſes.

This method of Conſtruction (were it not, that for every Caſe a new Hyperbole muſt be deſcribed) would not be inferior to that by a Parabole, but rather exceed it; in that the Circle doth not arcuate the ſame way which the figure doth, but croſſes it the other way; by which means a clearer diſcovery (as to the one moyety) of the points of interſection of the Circle with the Hyperbole is obtained, than what can poſſibly be had in any other Coni-ſection.

3. The Geometrical Conſtruction of ſome Æquations which aſcend to the *5th* and *6th* power, with the finding of their Roots, by a Curve of the third degree; namely by the firſt kind (for there are two kinds) of a Paraboleid and a Circle, illuſtrated with Schemes to each Æquation, and numeral Æquations adapted to them; with a Synopſis to the ſame for placing the Center and finding the Radius, and a general little Table, for the deſcribing of both kinds of Paraboleids.

4. The Conſtruction of all Cubick Æquations howſoever affected by a Circle only, Geometrically upon Suppoſition, that one *Poſtulatum* be granted to be Geometrical (which indeed is but a Supplement to Geometrical defects;) *viz.* That from any point aſſigned in the circumference of a Circle (that is normaly quadriſected) may be drawn a right Line, ſo that the parts intercepted both ways by the Circumference and Diameter, may be equal to the Radios of the Circle: this way (though not ſo purely Geometrical as the reſt) is not to be deſpiſed, ſith that theſe Lines may ſufficient preciſely be ſo drawn.

5. The Geometrical Conſtruction of all Cubic Æquations according to the Rule found out by *Franciſcus a Shooten*, mentioned in his Commentaries on *Des Cartes*, *Lib.* 3. *Pag.* 328, 329, 330, illuſtrated with Figures and Numeral Æquations adapted to each Figure, *&c.*

6. The Reſolution of all Cubick Æquations in numbers not only by a general Rule (by the aſſiſtance of any Figure reſolving them Geometrically *&c.* but by a more particular method far exceeding any extant in numbers or by help of tables; illuſtrated with Figures and Examples in numbers, ſuited to each figure and Æquation.

7. Mixt or Compound *Trigonometry*; in many inſtances far exceeding the ſimple, as finding two *Quæſitas* (as it were) by one operation, or by two at moſt; with a Synopſis of the admirable harmony between Plain and Sphærical Triangles: for inſtance,

In plain Rectangular Triangles, the ▭*e* under half the ſum of the *Hypotenuſe* and one ſide: and half their difference, is equal to the Square of $\frac{1}{2}$ the other ſide, ſo in Sphærical Rectangular Triangles. The ▭ under the Tangents of half the ſum and half the difference of the *Hypotenuſe* and one ſide: is equal to the ſquare of the Tangent of half the other ſide.

Again in Obliquangular Plain Triangles.

$$\begin{matrix}cs,\\ s,\end{matrix}\ \tfrac{1}{2}Z\angle\angle.\ \begin{matrix}cs,\\ s,\end{matrix}\ \tfrac{1}{2}X\angle\angle : \tfrac{1}{2}\ Baſis\ \begin{cases}\tfrac{1}{2},\ Z\ crurum.\\ \tfrac{1}{2},\ X\ crurum.\end{cases}$$

Thus likewiſe in Sphærical Obliquangular Triangles.

$$\begin{matrix}cs,\\ s,\end{matrix}\ \tfrac{1}{2}Z\angle\angle\ ad\ Baſem.\ \begin{matrix}cs,\\ s,\end{matrix}\ \tfrac{1}{2}X\angle\angle ad\ Baſem{:}t\ \tfrac{1}{2}Baſis.\ \begin{matrix}t,\tfrac{1}{2}Z\ Crurum.\\ t,\tfrac{1}{2}X\ Crurum.\end{matrix}$$

Again in plain Triangles.

$\frac{1}{2}$ *Baſis*. $\frac{1}{2}$ Z *crurum* : $\frac{1}{2}$ X *crurum*. $\frac{1}{2}$ X of the Segments of the Baſe.

In

In Sphærical alſo.

t, ½ *Baſis*. *t*, ½ Z *Crurum*, *t*, ½ X *Crurum*, *t*, ½ X *Segmentorum baſis*, with infinite other alike harmonious.

To which is added the Geometrical Conſtruction of all Sphærical Triangles, by a moſt plain and eaſy uniform way, which is indeed of ſingular uſe.

Alſo a diſcovery of the Method by which *Vieta* (*Lib*. 8 *p*. 431 *&c*.) found out his Canonical Analogy of Sphærical Triangles, which he hath left undemonſtrated, but in this Treatiſe is diſcovered.

8. *Cardanus Promotus*, or *Cardans* Rules, or *Vieta's duplicata Hypoſtaſis*, *in infinitum*, carried on with a Table for the compoſition *in infinitum* of ſuch Æquations. By which means ſuch Canons are generally compoſed for Æquations of two Nomes (and in many Caſes for more) equal to a Reſolvend given.

9. A Continuation of *Vietas Apollonius Gallus*, *Appendicula*; 1. And his Problemes otherwiſe demonſtrated, wherein the Baſe and Angle oppoſite to the Baſe are always two of the *Data's*, and the other, either the perpendicular or the difference of the Segments of the Baſe, or the difference of the ſquares of the ſides, or the ſum of the Squares of the ſides, or the Sum of the ſides, or the difference of the ſides or their ▭, whoſe Geometrical effection was altogether unknown to the antient Analyſts, *Vieta ibid*.

10. *Vera & Genuina Symmetrica Climactiſmus*, by which means all *Aſymmetries* in *Algebraics* may be wiped off, and an Æquation found in any one of the unknown magnitudes propoſed, which ſhall never aſcend higher, than the double of the higheſt power firſt propoſed, by which alſo that moſt peplexing entangling inextricable way of *Vieta* may be laid aſide as uſeleſs, and inefficacious, though hitherto it hath been the only remedy. *Adverſus vitium Aſymmetriæ*, this treatiſe was many years ſince compoſed and laid aſide; but the Author lately meeting with the *opera Poſthuma* of *Monſciur de Fermat*, treating on the ſame Subject in his (*Varia opera Mathematica pag*. 58, 59, &c.) and finding that though he rightly hits the mark; yet that he goes not in a ſtreight Line to it, hath reviſed his old Copy, and compared it with *Fermats*; and which of the two, hath gone the Simpler way, the Author leaves to the judgment of others, being loth in the leaſt to take up the Gantlets againſt ſuch a famous man whom all the world admires.

11. *Apollonius*

11. *Apollonius magnus Gregorianus*, or a Treatiſe of four Geometrical proportionals, wherein divers ways are found to ſolve that Grand problem, which hath ſo amuſed the world, (*viz.*)

Having the ſum of all the Squares, and the ſum of all the Cubes, of four Geometrical Proportionals to find the Proportionals themſelves; with queſtions of the like nature, by low Æquations, without aid of Analytick Store.

11. Of Triangular Sections by a different method than what *Anderſon* has performed it by, in *Vieta*, with a diſcovery of the falſhood (as to angular Sections) of Mr. *Oughtreds* 1*ſt.* Rule, in his *Clavis Mathem. c.* 16. *p.* 14.

12. The finding out of Æquations which may infinitely aſcend, whoſe Roots are either in Arithmetical or Geometrical proportion which may be found out in numbers by extracting the Square and Cube Root, with ſurd Canons adapted to that purpoſe, and to many other Æquations.

13. A Miſcellancy of the ſolution of many knotty Problemes, namely, ſuch as have been found difficult to be brought to any Equation, or elſe would mount very high *in Ordine Scalæ*, with a new method of Depreſſing them, by aid of one or two Æquations, raiſed by altering the Data, and putting two unknown quantities, by which means the adjutant Æquations as having the ſame common root, depreſs the Æquation that otherwiſe ſhould be reſolved.

ADVERTISEMENT.

THe Author herein ſuppoſeth the Reader to underſtand the uſe of common Symbols deſcribed in his firſt Book; *ziz.* cs, for *Coſine*, s, for *Sine*, Z for *Sum*, X for difference, ∠ for *Angle*, ∠∠ for *Angles*. And the Reader muſt be informed, that as the whole ſeems novel, ſo a brief Demonſtration of thoſe Propoſals in *Sec.* 7. to hold in Sphæricals is moſt deſirable; and if others be not wanting in their encouragements, its not to be feared the Royal Society will be ſlow in theirs.

[illegible] The [illegible] mean, fun [illegible] for the [illegible]

[illegible] and the [illegible]

[illegible] nature, by [illegible]

[illegible] method than who [illegible] with a [illegible] of the [illegible]

[illegible]

[illegible] people, the [illegible]

[illegible] the D [illegible] above mention'd [illegible] the same [illegible]

[illegible]

[illegible] be informed, that as the whole [illegible] Demonstration of these Proposals in Sec. 7. [illegible] it is most desirable; and if [illegible] be not want- [illegible] encouragement, is not to be [illegible]